IEEE life members newsletter

Welcoming Remarks

T. Scott Atkinson, Chair, IEEE Life Member Committee (LMC)

In this issue of *IEEE Life Members Newsletter*, we are taking a look back at our 2020 Life Members (LMs) activities and progress while we forecast events for 2021, with LM engagement and support of IEEE programs of interest to LMs at the forefront.

This year has been one of assessment and reflection for the IEEE Life Members Committee (LMC)—who we are, what we do, and how we can make the most impact on you, our 34,000+ LMs.

We began the year reviewing our charter, considering that we are a joint committee of IEEE and the IEEE Foundation. For IEEE, we report to the IEEE Member and Geographic Activities (MGA) Board through its Member Engagement and Life Cycle Committee. Next, we performed an in-depth review of our internal operations and took steps to improve our overall operation. For more information on LM activities and structure, see **lifemembers.ieee .org**. To aid in handling all the functions of the LMC, we established some ad hoc committees: Finance, Life Members Fund (LMF), Life Members Affinity Groups (LMAGs) Activities, Grants/Special Projects, Membership, and Operations. These subcommittees performed analysis in their respective areas and made recommendations to the Operations Committee, which was empowered to handle the administration of the LMC between regular LMC meetings.

During our reviews, we conducted a thorough analysis of our financials to include all our supported programs and

IEEE Life Members Committee Chair T. Scott Atkinson

implemented enhanced management controls to improve the oversight of funding. We found out that donations were not keeping pace with our ability to fund worthy programs.

Quick Status Update of Our LMC Activities

- All meetings are being held virtually due to the pandemic.
- The IEEE Foundation and the LMC have put the joint Grants Program for 2020 and 2021 on hold. We are evaluating how to best amend the existing grant process to efficiently support IEEE initiatives.
- A new special project funding opportunity is being developed—more details to follow soon.
- The LMF is excited to partner with the IEEE Foundation and encourage LMs to join the IEEE Heritage Circle: **https://www.ieeefoundation.org/donors/heritage-circle?**.
- Sponsorship funds from IEEE Sections Congress 2020 were returned and are now available to be repurposed to other programs or projects.
- Thanks to the donors to the LMF, we continue to proudly support LM newsletters, LM History Committee Fellowship, Bernard Finn Prize, LMAG activities, the Life Member Graduate Fellowship, and the IEEE James H. Mulligan, Jr. Education Medal.
- One visible change this year is that members with an email address will receive this newsletter via email. This is a cost-reduction measure due to declining donations. Those members

who do not have an email address will still receive their newsletter in a print version. We regret the need to make this change and hope for a better future.

Looking Ahead to Our Focus Areas in 2021

- Establishing new LMAGs in IEEE Sections with 50+ LMs
- Increasing the LMAG activities for all LMs and other long-serving members
- Expanding the philanthropic programs supported to include oral histories, technical tours, IEEE Young Professionals program activities, student programs, special projects, and recognition of outstanding accomplishments of our LMs—watch for the March 2021 *IEEE Life Members E-newsletter* to learn more
- Launching a new campaign to grow the LMF by US$1.5 million to expand our ability to achieve our long-term philanthropic impact for IEEE (please consider making donations: **give.ieeefoundation.org/ lifemembers**).

Since this is the end of another year, we say thank you and farewell to some of our LMC members whose terms are ending and, as a result, we will welcome some new members beginning in January 2021. The new members are to be announced at the conclusion of the IEEE MGA Board meeting in November and will be posted on our web pages.

We hope that the LM newsletters are achieving their goal of improving the communication between the LMC and LMs to ensure that members remain informed and engaged. Please feel free to contact your local LMAG chair, regional coordinator, or me at s.atkinson@ieee.org with your suggestions for future editions.

IEEE Life Members Help "Girls Make Tech with Heart"

Girls Make Tech with Heart is my favorite annual event of the Buenaventura Section, explains Doug Askegard, IEEE Life Member (LM). "When something is taught with a pure sense of joy, the learning becomes indelible. I am grateful to the IEEE Foundation for funding this program and enabling it to become what it is today."

This sentiment is shared by other LMs and volunteers who have made Girls Make Tech with Heart an experience to remember. Joy comes first in the list of goals, and all activities are designed to lift the spirit, not only in the participants but also in the mentors and organizers. In that moment of happiness, concepts of engineering are inserted experientially. For the past three years, the underlying theme has been *Aging Graciously with Technology.*

Approximately 150 girls, ranging in age between nine and 14, arrive from different parts of Ventura County, California, on a Saturday, some venturing for the first time, to this free science, technology, engineering, and mathematics (STEM) event consisting of workshops involving emerging technologies: sensing electronics, audio recognition, Arduino programmable kits, robotic arms, smart fabrics, infrared imaging, and virtual reality technologies—all focused on being beneficial for assisted living.

IEEE BUENAVENTURA SECTION

IEEE Life Member Mohammad Tehrani works with girls on "Robot Loving Sun," one of the workshops of Girls Make Tech with Heart. It involves the use of solar technology to drive robots made with recycling material, such as empty cans or plastic bottles.

How It All Began

The idea for the annual event emerged from an IEEE talk presented by Nathalie Gosset in 2015: "Technology in Our Future—An Ally in Graceful Aging." It was carried live on the government access television channel of the Thousand Oaks, California, Council on Aging. "Technology is essential to postponing problems that appear with cognitive decline in older age," says Gosset. "It is unreasonable to assume that the person facing the problem will realize that things have changed. With thoughtful planning, quality of life can be extended and gracious aging supported."

This message resonated well with the environment in which the Buenaventura Section operates. More than half of the 638 IEEE Members have 30 years or more of experience in engineering, with 26% being LMs. This creates an engineering cohort nurturing their technical relevance with an eagerness to be of value to the community. It is the ideal setting for member engagement to learn about, and make a difference in, the life of the aging population as well as to address one of the county's imperatives: having more students enter technical professions in Ventura County to meet the demands of industry. After a successful pilot event, the Buenaventura Section applied to the IEEE Foundation grant

program to enable the Girls Make Tech with Heart event to be further developed and reach more girls in Ventura County.

Today, the program includes parents who are invited to get engaged in a parallel, cojoint conference in an adjacent building. "Parents seem to have as much fun as the girls," states Gosset. They participate in their own STEM workshops and attend talks: "The Brain Development From Childhood to Adult Life and Approaches to Accelerate the Learning of STEM," "Jobs of the Future That Await Your Daughters," "Cybersecurity for Your Daughter," and "Aging Graciously With Technology."

Meeting Its Mission

The drive of Girls Make Tech with Heart is to

- Connect engineering with a philanthropic pursuit that feels relevant to a middle school girl. The talk "Aging Graciously With Technology" brings discussion about ways to diminish the isolation of the elderly, help adults with older parents care for their parents more efficiently, and lower the dependence on costly services provided to home-bound senior citizens.
- Nurture an interest in STEM in middle school, high school, and college students by actively involving them in formulating solutions for the generation of their grandparents.
- Develop a sense of empowerment in girls and enable them to develop possible solutions for their aging grandparents.

One of the workshops, "Helping Hand," focuses on robotics in service of assisted living. The girls build robotic arms and use them in interactive games.

Proud of the Program's Success

The "Aging Graciously With Technology" workshop has been running since 2015 with great success. This program has been selected three times by the IEEE Foundation as a grant recipient. The Buenaventura Section received the prestigious IEEE 2019 Educational Activities Board Section Professional Development Award for this initiative. The event is a great example of LM engagement with youth and our future.

Jamieson Awarded the 2020 IEEE James H. Mulligan Medal

IEEE Life Fellow Leah H. Jamieson has been awared the 2020 IEEE James H. Mulligan, Jr. Education Medal "for contributions to the promotion, innovation, and inclusivity of engineering education." Jamieson has devoted much of her career to establishing innovative education programs in engineering, attracting women to computing disciplines, and increasing public understanding of engineering. She cofounded the Engineering Projects in Community Service (EPICS) program at Purdue University to ensure that the technical education of students occurs alongside the development of professional and leadership skills in teamwork, creative problem solving, and ethics.

Jamieson has been a leading voice on issues affecting women and minorities entering academic careers through

Leah Jamieson is the Ransburg Distinguished Professor of Electrical and Computer Engineering at Purdue University and the recipient of the 2020 IEEE James H. Mulligan, Jr. Education Medal.

programs including outreach and leadership development efforts with AnitaB.org and mentoring programs through the Computing Research Association's Committee on the Status of Women in Computing Research. She is the Ransburg Distinguished Professor of Electrical and Computer Engineering at Purdue University, West Lafayette, Indiana.

The IEEE James H. Mulligan, Jr. Education Medal was established in 1956. The award is cosponsored by the **IEEE Life Members Fund** and others.

This year, in light of the global health emergency and pervasive travel restrictions, IEEE made the difficult decision to refrain from holding the in-person IEEE Honors Ceremony. Instead, Jamieson and the other 2020 IEEE Medal and Recognition recipients were honored in a series of online promotions.

IEEE Life Members Enable Research of the History of Technology

The prestigious IEEE Fellowship in the History of Electrical and Computing Technology recognizes a deserving scholar for one year of full-time graduate work or one year of post-doctoral research to support important historical research in any field of interest covered by an IEEE Society. This unique fellowship, dedicated specifically for the history of technology, is funded by donations to the **IEEE Life Members Fund**.

Daniela Russ recently received this honor to continue her research in 2020–2021. Her research focuses on the making of energy resources since the 19th century and the organization of capitalist and socialist energy economies in the 20th century. Her thesis is "Computers, Optimal Planning, and the Science of Energetics in the Soviet Union (1951–1982)." She is also working on a book, *Working Nature: Steam, Power and the Making of the Energy Economy (1830–1980).*

Russ is a postdoctoral fellow and historical sociologist at the University of Toronto and the University of Guelph, Canada. She earned her M.A. degree in social sciences from Humboldt University, Berlin, and her Ph.D. degree in sociology (summa cum laude) from Bielefeld University, Germany. She was a Fulbright scholar with Timothy Mitchell at Columbia University (2016–2017) and, together

Daniela Russ will continue her research on the making of energy resources since the 19th century and the organization of capitalist and socialist energy economies in the 20th century.

with Thomas Turnbull (the Max Planck Institute for the History of Science), holds an Independent Social Research Foundation Flexible Grant for Small Groups (2020–2021).

The IEEE Life Members Committee and the IEEE History Center: 40 Years of Partnership

In August 1980, Dr. Robert Friedel arrived at the United Engineering Center in New York City, where IEEE was headquartered. He had been hired to direct a new "Center for the History Electrical Engineering" (later shortened to the IEEE History Center), which was to be the staff arm of the IEEE History Committee in its mission to preserve, research, and promote the history of IEEE; its members; their professions and industries; and related technologies.

The IEEE History Committee had existed since the 1963 merger that formed IEEE out of the American Institute of Electrical Engineers (AIEE) and Institute of Radio Engineers (IRE). It and the IEEE Life Members Committee (LMC), which was originally called the *IEEE Life Member Fund Committee*, were two of the first "standing committees" (as they were then called) to report to the IEEE Board of Directors. The LMC [shorthand for both the IEEE Life Member Fund (LMF) Committee and the IEEE LMC, as it would later be called] and the LMF actually predated the merger with the AIEE. The LMC had always expressed an interest in preserving history on behalf of Life Members (LMs), and the existence of two prominent committees at the same organiza-

tional level prompted collaboration. In 1967, Harden Pratt became chair of the History Committee and a member of the LMC and proposed that the LMF be used to fund history projects. His idea was enthusiastically accepted. The first grant was in 1969 to fund storage and display cases for archival materials at IEEE headquarters, which would become the ancestor of the IEEE Archives.

Dr. Bernard S. "Barney" Finn, a key long-term consultant and member of the History Committee, was the curator of Electricity at the Smithsonian Institution. He convinced the LMC, beginning in 1973, to fund a summer intern at the Smithsonian to produce an inventory of electrical collections in libraries and museums around the world. In 1974, the LMC supported the History Committee in undertaking some oral history interviews to preserve the memories of prominent LMs. These tapes were not transcribed at the time but later became the core of the important IEEE Oral History Collection. In 1978, the LMC established a graduate fellowship in the history of IEEE fields of interest. Over the years, the winners of the prestigious fellowship have gone on to become leaders in the global history of technology community.

IEEE History Center staff with IEEE President José M. F. Moura at the dedication of the "Standardization of the Ohm" IEEE Milestone in Glasgow, Scotland, U.K., on 17 September 2019. From left: Alexander Magoun, Kelly McKenna, Nathan Brewer, Robert Colburn, Mary Ann Hellrigel, President Moura, and Michael Geselowitz.

The creation of a professionally staffed History Center enabled the LMC to carry its support of history to a new level. The summer intern was transferred to the History Center and brought out further guides on historical collections in IEEE fields of interest. The IEEE Archives were formally established in the run-up to the IEEE Centennial in 1984. In that centennial year, IEEE established its Milestones Program, overseen by the History Committee and managed by the History Center. The LMC agreed at certain key points to support less-affluent IEEE Sections with funding, which helped the program grow to over 200 Milestones today. Oral histories were taken up again in a serious way.

In 1985, IEEE launched a "Friends" committee to raise additional philanthropic funds for the History Center, but this did not stop the continued partnership with the LMC. When the Friends decided to establish an endowment fund for the History Center, the LMC helped to seed it with a generous gift. In 1987, a history paper prize was established for the History of Technology, funded by the LMC and managed by the History Center. (It has since grown to be the prestigious Bernard S. Finn IEEE Prize.) It should also be noted that many LMs gave—and continue to give—to the LMF and the History Fund, which are both housed in the IEEE Foundation. At the same time, the existence of the new History Fund freed up resources for the LMC to fund more special history projects from other entities. These applications were vetted for the LMC by the History Committee, and the projects were overseen by the History Center.

The LMC also continued to support special projects by the History Center, especially in the area of oral history. In 1995, a grant from the LMC enabled the transcription of the earlier "legacy" oral histories so that they could be added to the growing collection (now over 800 interviews strong). Grants in the 2000s led to the publication of a book, *Dawn of the Electronic Age*, by History Center Senior Historian Frederik Nebeker. The History Center held a series of conferences, some of which were sponsored by the LMC, most notably the 2009 IEEE Conference on the History of Technical Societies held in Philadelphia on the 125th anniversary of the founding of IEEE.

Perhaps the largest History Center project underwritten by the LMC was the IEEE Virtual Museum. In 1999, IEEE and the IEEE Foundation agreed that the History Center needed an external facing site for the general public, separate from its pages on IEEE.org. The LMC joined the other two entities to make this a reality, and the successful IEEE Virtual Museum eventually evolved into the History Center's flagship site, the Engineering and Technology History Wiki. Most of the material found in this article (the history of the LMC, IEEE Milestones, oral histories, publications, and first-hand histories by LMs and others) can be found on the site at www.ethw.org.

As the History Center closes out four decades of preserving and making known the heritage of IEEE members, it looks forward to a future of continued collaboration with the LMC.

—Michael Geselowitz
Senior Director, IEEE History Center

New Member Discounts for Your Health

IEEE has expanded its member discount offerings with several new health and wellness benefits that seniors in the United States (excluding Utah, Vermont, Washington, and Puerto Rico) may appreciate. Members, regardless of age, may enroll in a discount vision plan, supported by the Coast to Coast Vision Individual Vision Program. This plan provides discounts on glasses, contact lenses, laser surgery, exams, and even designer eyewear for a low, monthly access fee. Coast to Coast Vision may be utilized at many national retail chains and thousands of vision care providers in the United States. Spouses and dependents (up to age 26) may also be covered under the member's plan. To learn more, visit https://www.ieee insurance.com/ieee-us/health-insurance/vision-insurance/vision-insurance.html.

The discount vision plan complements other benefits available in the IEEE Member Group Insurance Program, administered by Mercer. Graham Fuller, principal, business segment leader at Mercer Consumer, noted that, "Many members are already participating in the member-group MetLife Dental insurance plan, but we recognized that a vision plan would be another essential service we could offer. This is not insurance. It is a discount that will help members save money, and they can shop at familiar retail locations or online using this benefit."

In 2020, the IEEE Member Group Insurance Program also launched a health services bundle, which consists of Teledoc, counseling, and alternative health and wellness services. Teledoc, a leading name in telemedicine, helps members save time and money with 24/7 access to a doctor by phone or online video. There is a per appointment fee of US$15 for those who enroll in the bundle. The second feature is access to counseling services, which is unlimited and has no per visit fee. Members will get access to The KEPRO Employee Assistance Program, through which experienced counselors are available 24/7. Members can expect help with issues such as loss, grief, change, transition, or abuse. Confidential counseling is offered by phone through experienced practitioners who have a master's degree. The third feature in the bundle offers discount alternative medicine services, which includes many types of therapeutic services such as acupuncture, massage, nutritional counseling, and others. Members can access these services from a listing of participating practitioners and pay them a preset discounted fee.

The discount Vision Standalone Plan may be purchased alone for US$10/month. The Telehealth Package bundle charges US$20/month for access. Members save more if they enroll in the Complete Package for US$25/month, and there is no additional cost to enroll one or more dependents. To learn more, please visit https://www.ieeeinsurance.com/ieee-us/personal-insurance/telehealth-services.html.

—Lynn Koblin

Donate to the IEEE Life Members Fund of the IEEE Foundation With Confidence

The IEEE Foundation is proud to announce that its strong financial health and ongoing accountability and transparency have earned it a 100/100 rating from Charity Navigator's new Encompass Rating System version 1. This score designates the IEEE Foundation as an official "Give With Confidence" charity, indicating that our organization is using its donations effectively based on Charity Navigator's criteria.

This milestone achievement for the IEEE Foundation could not have happened without your support. Your trust in us is what makes the difference to us and the IEEE community. Please find our Charity Navigator Encompass rating here: charitynavigator.org/ein/237310664. You can learn more about Charity Navigator and the Encompass Rating System at charitynavigator.org/encompass, and donations to the IEEE Life Members Fund of the IEEE can be made at give.ieeefoundation.org/lifemembers.

Does Your Will Need a Makeover?

You did what you were supposed to, and you wrote your will. Congratulations! Now it's tucked safely away in a drawer, file, or security box. But when was the last time you looked at your will to ensure everything is still up to date? If it was more than five years ago, or if your life circumstances have changed significantly, it's time to take out that will, review it, and see if a makeover is wise.

It is a common misconception that wills are a "once-and-done" task. But the reality is that they can become outdated quickly. Consider an average couple: They diligently create wills shortly after getting married. But a few years later—after a layoff, a first home, two children, a start-up business, a new retirement plan, and then a second home—they have not even taken those wills out of the drawer once. Their lives have changed in big ways; their wills need to change, too.

Time Well Spent

Of course, wills are not fun. Who likes to think about their own mortality? But deep down, we all want to be prepared for the future. Making a commitment to review an existing will is time well spent—for your sake and for your heirs.

Consider this: Most of us write (or review) our will after a friend, loved one, or spouse dies; before traveling to a faraway place; or when suffering from an unexpected illness. The urgency of acting quickly and under duress may lead to omissions, missed opportunities, or even mistakes. Writing or revising a will is serious business; it's not the time for a hurried decision. Instead, conduct a will makeover when there's no looming deadline, emotional life circumstance, or emergency medical situation. Take your time. Concentrate on making sound decisions. Your will is an opportunity to make a lasting statement about what is most important to you. You owe it to yourself and your family.

During this important process, please consider a gift through your will to IEEE—the organization that has been a part of your life for a substantial amount of time—by including a bequest to the IEEE Foundation, IEEE's philanthropic partner. Visit the IEEE Foundation website at ieeefoundation.org/how-to-give to learn about all your giving options or contact Daniel DeLiberato, CFRE, IEEE Foundation development officer, at +1 732 562 5446 or d.deliberato@ieee.org to hold a private conversation about what is right for you.

On Matters of Money

In 1973, I started a company to mate a new technology, the floppy disk, with a 300-instruction-set programmable calculator. I called the result *a desktop computer*. This was a system to be made available to the small business world, an affordable desktop solution to business reporting needs. If not the first, it was certainly one of the earliest uses of random access technology applied to business applications (accounting, word processing, automated forms fill-out) at the desktop level.

I financed the new entity using a newly available government guaranteed loan program [from the U.S. Small Business Administration (SBA)]. This form of bank loan required personal collateral. My partner and I provided our homes for this requirement. As unthinkable as it is today, back then, Chicago venture capital sources for technical start-ups were essentially non-existent. The failure of such ventures generally left investors with nothing of recoverable value.

Fast forward eight months: The new venture had 35 employees mainly writing software, and, although the desktop computer unit had proven itself valuable to at least 40 users, 400 users were required to provide the cash flow needed to service our then-current US$500,000 debt and burgeoning payroll. To say the least, a review of company financials did not inspire investor confidence. To make matters worse, a second larger SBA loan, granted by the same bank, was about to default. We exhausted assets and could not provide additional collateral to pledge to support additional debt financing.

A very close family friend, a Chicago attorney, offered to present our case to a bank (which was friendly to him) that he was certain would issue a much larger SBA loan, sidestepping the additional collateral caveat. This loan would carry us over for at least another year, thereby preventing the foreclosure loss of the company and the existing collateral (expressly, the homes of myself and my partner). The hitch was that I would be required to execute a "consulting" contract for 10% of the loan face value to whomever my attorney friend named. Of course, this "contract" was simply subterfuge to bypass the SBA-mandated 1.5% limit on allowable fees for representative agents. Eventually, the pressure presented by the potential loss of the enterprise (and our domiciles) overcame my reluctance to be part of such a loan.

One night, I drafted a letter giving my attorney friend power of attorney to negotiate for our company in this loan application. After a sleepless night, I arrived at my attorney's home at 5 a.m. After much hemming and hawing, I retrieved the letter and destroyed it on the spot. Our enterprise eventually failed.

Never once in my entire entrepreneurial life did I ever regret my action. And never once did I ever again allow entrepreneurial pressures to cause me to entertain such behavior.

Marmon Pine
Wheeling, IL

Ethical Dilemma Submissions

Ethical dilemma articles are part of an ongoing initiative between the IEEE Society on Social Implications of Technology (SSIT) and the IEEE Life Members Committee (LMC). If you have an experience that involved navigating an ethical dilemma as part of your professional life, we invite you to consider sharing it with your colleagues through the SSIT or LMC newsletters.

A joint SSIT/LMC committee will vet all initial submissions, and authors will work with the editors of the two publications to finalize their submissions. Accepted ethical dilemma articles will be published simultaneously in the June and December issues of both newsletters.

Article submissions must be between 300 and 500 words in Microsoft Word format. The IEEE Legal Department requires that all articles be fully sanitized to protect the privacy of people and organizations. Please submit manuscripts to Rosann Marosy at r.marosy@ieee.org.

Lucky Strike With Missing Bytes

I would like to recount an experience that happened in 1989—when bytes were expensive and smoking was allowed at work. The company I worked for was designing a new fire-detection system. It basically contained several two-wire loops, each with combined power, plus signaling with up to 99 detectors, and a controlling 8051-type microcontroller per loop. Finally, there was a central processor. In addition, it should run some of the smoke detection algorithms as well as figuring out what each detector had in mind. Was a fast fire or a smoldering fire developing? Was the detector getting dusty? However, the first calculations revealed that we needed 16 b or 2 B of read/write RAM memory per detector, or 198 b—on a processor with only 64 B on-chip. Even worse, we had written a cooperative task scheduler that needed some 20 B. Topping it with variables and the stack, we saw no "fast track." We had not even heard that phrase, but there was one.

Code was written in PL/M-51. The hardware should be cheap; still, we could afford a serially connected external RAM containing 128 B, which was much less than we thought we needed. In the product that we were going to replace, we had used 6 b per analog value. We wished to go for 7 b this time, but we also needed the value from the previous scan (7-b resolution is always better than 6 b, we thought). However, after consultation with the manager, it was confirmed that the smoke level wasn't really that fine grained: 16 levels in 4 b would probably do. Less was to become more. I would be able to cram all state info into 8 b per detector.

However, we now had more smoke change per score, so I had to introduce hysteresis. It should be hard to get into higher score and equally difficult to get into lower values.

On my way to one of the meetings, I carried my prototype and a battery to show to my fellow engineers. I made the processor signal a beeper each time a new score was entered. As the tobacco smoke filled the room, we could hear it beeping over the discussions. Back from the meeting, the unit beeped again, since I never smoked myself.

After some days of bicycling back and forth to work, an idea appeared. Perhaps I could count the number of score changes? Would this indicate how well the smoke detector had been located? It turned out that it did exactly this. A detector that had been mounted close to a ventilation outlet or a door with plenty of traffic through it saw an increased count. After a week or two, we could inform people about the quality of the installation. Some detectors would be moved to better locations and their count values decreased to normal levels. The fire brigade could remain more at home because the final result was a substantial decrease in faulty alarms. All of this resulted in a big competitive advantage for the company. It was just a few beeps away.

Øyvind Teig, Member
Autronica, Norway

Coming Unplugged

Years ago, I was a senior field electrical engineer for a company that manufactured distributed process control systems. At that time, prior to the widespread adaptation of personal computers and flat-screen displays, our operator console (Human Machine Interface) was a piece of stand-alone furniture with a large cathode ray tube display and custom keyboard. We had recently shipped a system to a customer in a Midwestern state. The customer called me shortly after he received it and set up the system and informed me that one of the consoles was not working. I asked the customer if I could pose some questions in the hopes of troubleshooting the console issue by telephone to get an immediate resolution to the problem. The customer agreed.

I first inquired, "What exactly is the console doing? Is the power light on?"

The customer testily replied, "The console is doing nothing, and the power light is not on."

I then asked, "Could you check to make sure the console is plugged in to the power receptacle?" The customer replied (using language that cannot be repeated here) that he was not stupid, and of course he checked to make sure it was plugged in. I told him that I would refer the issue to my supervisor and we would get a local service technician out as quickly as possible. I talked to my supervisor, who informed me that he had no one local to send to the customer on such short notice and that I, a senior engineer, should go. I could certainly address the console issue.

I bought my plane tickets, packed my test equipment, and took a 6 a.m. flight the next day from our Mid-Atlantic location to the customer's site in the Midwest. After arriving at the customer's site 5 h later, I was escorted to the offending console. I actuated the power-on switch and, sure enough, nothing happened. I then took a flashlight and looked at the back of the console, where the power plug was laying on the floor. I plugged the power cord into the wall receptacle, and the console came to life. It now operated as intended. Needless to say, the customer was embarrassed and apologized for his short temper. He then asked me if he would be charged for this service call since the console was under warranty. I replied that I had asked him if the console was plugged in to power, and he had responded that it was. I explained that providing power to the console was not covered under the equipment warranty and that he would be billed for the service call at our standard rate. I then headed to the airport for the return home. After that encounter, the customer and I were friends for many years.

Philip M. Leibowitz, LSM
Baltimore, Maryland

Dripping Aluminum

In the early 1970s, I spent a few years working as an engineer performing device failure analysis at an aerospace company in Maryland. The labs were fully instrumented for complete device evaluation by electrical, optical, structural, mechanical, and chemical means. There was keen interest in determining exactly why every failure occurred. Most of the devices that were analyzed were semiconductor-based integrated circuits and transistors used in electronics. Every once in a while, however, a job of a different sort would show up for analysis.

I was given the task of determining why an electrical-resistance heating rod had failed. Rod dimensions were about 4 ft long with a 1-in diameter. After determining the location of the defect, and using a brick saw to cross-section the rod, I was able to determine where the rod had an electrical short. This was likely due to a defect in the rod, which, under electrical and thermal stress, allowed metal to bridge the gap between parallel, oppositely running current lines of the heating element. That is, the lowered heater resistance allowed more current to flow than the design allowed. The standard arrangement for preventing thermal runaway and protecting the rod from overheating by shorted condition was to use a circuit breaker. Unfortunately, this rod had no protection and, as a result, was able to heat up way beyond design limits. Herein lies the real story. The night watchman who discovered the faulted condition was curious about a dripping noise that he heard in one of the large bays that were part of his nightly route.

As a bit of background, the labs used gaseous dry nitrogen for things like backfilling a chamber to clear out humid air or oxygen. The source of the nitrogen gas started with a tank that fed liquid nitrogen into a pipe manifold, which then fed out nitrogen gas. As the liquid heated up, nitrogen gas was generated. To generate gas faster, the manifold was placed next to heating rods. To make better thermal contact between the manifold and the heating rods, they were both inserted into opposite ends of an aluminum cylinder that had been filled with aluminum dust. The cylinder was about 6 ft long and 1 ft in diameter and was bolted to the bay ceiling.

The dripping sound that the night watchman heard that night was molten aluminum falling from the bay ceiling onto the floor. This resulted from the overheated heating rod, which had no electrical protection, generating so much heat that it melted the aluminum dust and the container wall. Aluminum melts at 660 °C or 1,221 °F. Although it would have cooled somewhat from falling through the air, it was still much hotter than boiling water.

Tony Marques, LM
Lexington, MA

The K100-D Story

I joined a small test and measurement company in Cupertino, California, in 1973. It designed and manufactured transient digitizers, built from analog-to-digital (A/D) converters of its own design. The top of the line was an 8-b, 100-MHz instrument. When IBM got a hold of one, it removed the A/D, installed level detectors, and created an instrument for timing analysis of digital circuitry. Once we discovered IBM's creation, we perceived that there must be a need for other instruments of that nature. We embarked on a program to develop a line of such instruments.

We displayed several models of logic analyzers at the 1976 WESCON show. As a result of feedback from customers at the show, we decided to embark on the development of a bold new instrument. It would have 16 input channels, individual active high-impedance input probes, a built-in video display, and keyboard control input and be microprocessor-controlled. It was christened the K100-D. The heart of this new instrument was the Motorola 6800 microprocessor.

As the product manager for digital instruments, it fell to me to help the design team interpret the needs of our customers and embody features and functions into this new instrument that would meet those needs. A good bit of my responsibilities included traveling and meeting engineers in the field to discuss their needs. I was able to bring this knowledge back to the factory and share it with the design team.

The K100-D was introduced at WESCON 1978 and became a resounding success. In its first year of production, it outsold its sales projections by a significant factor. However, it turned out that the supply of dynamic RAM, the storage medium for the captured data, became tight. We actually had to redesign the memory boards three times to accommodate whatever high-speed dynamic RAM chips were available. This put major crimps in our delivery schedule.

The input probes were a development struggle: They were conceived as custom hybrid circuits, incorporating threshold detection, overvoltage protection, and mechanical integrity. These became hard-won achievements. Another challenge was the integral graphic display. We decided to incorporate a 7-in raster scan display. The advantages to this type were higher contrast than that of a flying-spot display as well as a larger format. However, we were unable to source a suitable monitor with the requisite display linearity, which was so crucial when displaying timing diagrams. We ended up designing the electronics around an electromagnetic deflection cathode ray tube and achieved display linearity of less than ± 1% across the face of the tube.

At the time of development, a comprehensive emulator for the Motorola 6800 was not available, so we wrote the operating system (OS) code in assembly language and debugged it in situ. The resulting code was compact and executed very rapidly. The OS occupied 28 KB of ROM, and the system had 32 KB of RAM. Finally, to implement automatic testing in manufacturing, every K100-D was equipped with an IEEE 488 interface.

The profits from this instrument funded follow-on instruments that furthered the state of the art in logic analysis.

Ed Jacklitch, LSM
San Jose, CA

The Groundhog Test

As a principal engineer at a small automation company that made pharmaceutical testing instruments, I was responsible for assuring regulatory compliance for most aspects of our products, from radio-frequency (RF) emissions to operator safety. Some of the most important items were compliance to EN 61010-1, *Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use*. For example, one clause in part 12 requires that "No flaming or molten material shall be emitted under normal nor single-fault operation" (but it's ok if the perils stay inside).

First, of course, I would complete the electromagnetic compatibility tests for radiated and conducted RF emissions and RF and electrostatic discharge susceptibility before the safety tests, which often damage the equipment under test (EUT). The first phase of safety testing was to assure proper grounding, correct power-entry connectors, power-input leakage, exposed hot-spots, and accessibility of lethal voltages by the test finger, among others. But the second, braver phase was the Groundhog Test. First, the EUT was configured for a nasty single-fault failure (of the examiner's choice), for example, the EUT configured for 120 V but powered by 230 V. Then, the examiner faced away from the EUT, reached behind herself, and, while watching the wall, turned on the power switch. If she saw her shadow, there would be six more weeks of debugging.

John Roe, LM
Uxbridge, MA

A Galvanizing Episode

Broken Hill Proprietary (BHP) is a large international iron/steel/oil conglomerate that had a research complex in Melbourne, Victoria, Australia. I was fortunate enough to earn a position there in 1972 that eventually, in 1977, became a research post as the electrical member of an internal think tank tasked with finding new technologies to widen BHP's operations. Other companies within the BHP group were encouraged to consult us on any topic that related to their operations.

One such other division is Australian Wire Industries (AWI), which makes wire and wire products. One of its primary products is galvanized wire that is commonly used for fencing and the basis for many other products. The galvanizing process used was hot dipped, where the wire was fed into a large bath of molten zinc from which it would exit vertically to allow the excess zinc to run back into the bath. The primary problem was the speed at which the plant could be run while maintaining an acceptable finish and coating weight

on the wire. Industry practice was to have a gravel bed at the point of exit so the excess would be scraped back.

AWI discovered that introducing a sulfur-bearing gas into the gravel bed caused the formation of a strong film of zinc sulfide to quickly form and not only aid the zinc retardation process but also give a very good smooth finish, which is commercially important. AWI's patents were licensed worldwide, and it came to us to find a new method for the process (called gas wiping) so it could maintain leadership in the industry.

We discussed the problem at length and finally decided it was too hard for an advanced chemical or mechanical approach, so my idea of an electromagnetic liquid metal pump was given the task. All I had to do was develop an electromagnetic device that could operate in a 400-°C (750-°F) environment. After considerable research into liquid metal pumping and the rheology of zinc, I designed and built a small (150-W) three-phase cylindrical pump that barely worked on the bench, but the

revealed frequency was not as important as expected. The next version was more robust (2 kW) and made to operate while immersed in zinc at 400 °C. My materials problems were eased by the company's steel division, which had experts on high-temperature materials and who were very helpful supplying all my needs.

The next discovery was that a single-phase coil could provide results equal to the polyphase design, so we upped the power to about 4 kW and made the pump open sided and suitable for 10 wires, a requirement for production applications. I constructed the pump from square copper conductor wound on a stack of laminated C-core halves with plenty of alumina paste to hold it together. Our patents are 41664/78 (Australia) and 4228200 (USA). My work continued with a bench-scale simulation rig using gallium liquid at 40 °C, where I attempted to plot the flow around the exiting wire using Faraday probes.

Tony Sander, LM
Sonora, CA

A Bug in the System

We both joined the Virginia Tech faculty in 1969, beginning over 50 years of collaboration and friendship. In 1972, we began work on a NASA-sponsored project to characterize propagation of 10–30-GHz signals on satellite downlinks. Rain attenuation (fading) and depolarization (changes in wave polarization that would introduce cross-talk between channels) were the big concerns, and the first step was to measure and analyze these effects on a terrestrial path. To do this, we built a 1.65-km, 17.65-GHz radio link from a transmitter on an elevated platform to a receiver on the roof of a campus building. Both the transmitting and receiving antennas were parabolic reflectors with dual-

polarized feed horns set for linear polarization 45° on either side of vertical. An electromechanical waveguide switch routed the transmitter output to each polarization in turn on a 4-s cycle, and we measured the output of both receiver channels. In clear weather, the copolarized channel output (the one corresponding to the transmitted polarization) was about 45 dB above the cross-polarized channel output. In heavy rain, this difference could become as low as 10 dB, as raindrops scattered energy from one polarization to the other.

It was the Thursday afternoon before our first crucial NASA visit on the following Tuesday. Bostian was looking at the received signal levels as printed out in our laboratory when

the cross-polarized signal started jumping around and then stabilized at a value equal to the copolarized signal. Our rooftop receiving antenna was in an area where housekeeping staff occasionally took breaks, and our first thought was that someone had put something in the radio path. Unfortunately, it was not this simple. We worked the rest of that day and every day after that (Saturday and Sunday included) starting at the receiving antenna and checking every component and system, without success. By Monday morning, the only thing left was the transmitting antenna. Stutzman climbed up on its elevated platform, looked into the translucent plastic covering the mouth of the feed horn, and began to yell. He

found the problem—a very dead housefly inside the feed.

It turned out that, on the previous Thursday morning, a graduate student had disconnected the transmitter from its waveguide and left the waveguide open for several hours. The fly entered the waveguide and somehow made its way through about 4 m of microwave plumbing and ended up in the feed horn, where it could see light but not escape. With the transmitter replaced, the microwaves soon cooked the fly, and it died at the point in the feed where it could scatter the most energy from one polarization to another. That fly must have been a genius at navigating mazes—too bad we couldn't have given it to the psychology department.

We removed the fly, and the NASA visit went well. Stutzman still has the dead fly in a bottle—a memento of our first big project.

Charles W. Bostian, LF
Blacksburg, VA

Warren L. Stutzman, LF
Blacksburg, VA

Digital Frequency Synthesis

Prior to the 1950s, the operating frequency of a military radio was controlled by a crystal oscillator, which necessitated multiple crystals for operation at different frequencies. The 1960s development combined a voltage-controlled oscillator with a programmable digital divider and embedded this within a phase-locked loop (PLL) to enable many operating frequencies to be "synthesized" from a single stable crystal oscillator by changing the division ratio. In the United Kingdom, both Plessey and Racal were pioneers in advancing these indirect frequency synthesiser military radio designs.

The Clansman HF, VHF, and UHF man-pack and vehicle-based combat net radio system was used by the British Army from 1976 to 2010. These military radios, which were constructed by Plessey, Racal, and Philips MEL, introduced single sideband operation and narrowband frequency modulation to forward area combat net radio. In the 1960s, at the early stage of microelectronics development, the programmable dividers and other synthesizer circuits were built at Plessey as custom integrated circuits (ICs) in resistor transistor logic. Radio frequency selection was controlled by manual switches to select the required divider ratio. Also, there was a necessity to introduce a fixed offset to control the different transmitter and receiver frequencies for a given operating frequency. The design of the loop filter was critical to minimize spurious signals and achieve acceptable switching time between channels. As all this was achieved well before the advent of computers, the IC designs had to be created manually on large sheets of graph paper before cutting Rubylith sheets to make the oversize masks required for the IC fabrication. I was a member of the frequency synthesizer group at Plessey from 1966 to 1970, designing the phase comparator circuits, after undertaking six months of IC design training at Plessey Caswell Research Center.

At the same time, Racal's first HF synthesised manpack radio, Syncal, covered the band 2–7.999 MHz in 1-kHz steps with an intermediate frequency of 10.7 MHz, requiring the receiver synthesizer to operate from 12.7 to 18.699 MHz. In the 1960s, Racal Instruments also produced a 0.1–160-MHz synthesized signal generator, in 10-Hz steps, for automatic testing of the Clansman radios. These PLL synthesizers, which used early Fairchild digital dividers, were pioneered by Keith Thrower, who developed the required theory from scratch. For many years, Keith led Racal Research in Reading, England.

In 1978, Racal expanded this into its Jamming Resistant or Guarded Frequency Hopping Radio (JAGUAR).

The JAGUAR V VHF combat net radio, with a 50-km range, hopped the transmission frequency over a band of frequencies making it much more difficult for the enemy to eavesdrop on, or jam, the radio communication. By the late 1970s, much of JAGUAR's microelectronic circuitry was incorporated into a custom complementary metal–oxide–semiconductor large-scale integration chip, designed by Racal Microelectronics. The equivalent U.S. equipment was the Single-Channel Ground and Airborne Radio System. Slow frequency hopping was a very important development, as it later became an essential requirement of the first and subsequent generations of cellular radio transceivers to overcome transmission loss due to deep fading when located in propagation nulls. The company Vodafone, as spun out of Racal, is currently one of the major cellular operators.

Today, these PLL synthesisers have been superseded by advances in microelectronics that have enabled direct digital synthesis. Here, the signal is generated by fast digital sampling of the waveform, followed by digital to analog conversion and low-pass filtering to directly synthesize the required analog signal frequency.

Peter Grant, LF
Edinburgh, U.K.

An Accelerated Career

I grew up in England, and when World War II (WWII) ended, I was 13. England was awash in war surplus, and much of it was very nicely built American electronic equipment. While still in school, I assembled a wide variety of gear from parts, including a closed-circuit TV (stills only). After university and military service, my first paying job was with an aircraft firm building a stand-off missile. I worked for the people designing the autopilot and navigational gear. It had been decided to use magnetic amplifiers, devices that utilized the properties of so-called "square-loop" magnetic cores. This technology was initially developed in Germany during WWII to operate the control surfaces of the V2 rocket. "Mag-Amps" could control significant amounts of power and were very rugged.

I emigrated to Canada in 1957. At my first job interview, the company hired me on the spot. A salesman had entered a bid to fix a problem on a new airliner built in California; when the wing de-icers were connected to the aircraft alternating current supply, the sudden load caused fluctuations that upset the autopilot. The salesman said his company could build a device that gradually applied power. They were asked to supply a prototype, but no one knew how to do it. I built a prototype using saturable reactors; the dc control winding was powered by a newly available Honeywell power transistor connected to a resistor–capacitor network. Later, I worked on the autopilot for the Avro Arrow, a very advanced jetfighter under development. The control surfaces operated via a carrier-type servo with input from the pilot's control column. The response had to be modified depending on just where in the flight envelope the plane was flying. This required a carrier demodulator, a filter circuit specified by the aerodynamicists and a modulator, in the pitch, roll, and yaw axes and a spare channel. The whole thing was an afterthought, and I had only 130 in^3 for the device.

Eventually, I went back to graduate school, and then I was hired by Brookhaven National Laboratory in Long Island, New York. I discovered it had just succeeded in getting a new particle accelerator to work, the most advanced in the country—the Alternating Gradient Synchrotron (AGS). Although it accelerated particles, the physics experiments were very limited until methods could be found to bring the beam outside of the vacuum chamber in which the particles were contained during acceleration. I spent several years just implementing that aspect of the machine. Initially, the electronics used vacuum tubes, but these rapidly gave way to transistors, integrated circuits, and even small computers. The timing was tricky; the particles were traveling in bunches at almost the speed of light. I built a magnetic pulser to switch the beam into an external vacuum pipe using a delay line discharged by a large hydrogen thyratron; the rise-time of the field was 200 ns. I built an experimental device to focus the external beam using a capacitor bank to excite a plasma with a peak current of 250,000 A. Later in my career at Brookhaven, I became involved with the application of superconductors to accelerators and conventional electrical equipment.

Eric Forsyth, LF
Brookhaven, New York

Dealing With Dragons

In 1982, I was a manager with a technical consultancy in the United Kingdom. At the time, there was a boom in simple home computers like the Radio Shack TRS-80 and Sinclair ZX. The U.K. government was keen to develop new employment opportunities in Wales and helped the company Dragon Data develop a low-cost, U.K.-made competitor, and our consumer products group designed the hardware.

The Dragon 32, as it was called (dragons are big in Wales), was highly limited and the display quality [using a radio frequency (RF) modulator generating a signal to feed into a TV antenna socket] widely criticized. Every vertical feature was accompanied by a colored "ghost" just to its right, looking like the effect of an echo on a broadcast TV signal. You could even estimate the echo delay time by applying a ruler to the screen; it was about a half microsecond. Sales were suffering, customers were returning products, and our client was getting very impatient.

The design team was focused on the problem but totally stumped—the phase alternating line (PAL) video signal going into the modulator was completely clean, with no sign of any overshoot or echo. The team explained that, to save money, they used a Motorola 525-line National Television System Committee (NTSC) integrated video encoder chip, with ancillary logic to add 100 lines to get the 625 needed for PAL. Using this chip, already made in large numbers for U.S. products, simplified the design and cut costs. A few more pence was shaved off by using the same crystal, with the by-product that the actual line period was the NTSC 63.5 rather than the PAL 64 ms. TV sets seemed to happily cope with this, sometimes with a little adjustment of the horizontal hold.

Suddenly, I recalled the difference between "simple PAL" and "delay-line PAL." Early color TV sets used simple PALs, but once the component industry had worked out how to make a cheap, compact 64-ms ultrasonic delay line, sets quickly switched to

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delay-line PALs. This delayed the color signal for each line and averaged it with the next—because successive scans are highly correlated, it cancelled out differential phase errors making the system much more robust. Of course, if you have a signal with a 63.5-ms line period, the delayed signal is "averaged" a half microsecond later. The video system in the Dragon was doing exactly what the designers intended, but there was a fundamental mismatch between how they assumed TV sets work and reality, hence the "ghost."

A solution was far from easy, requiring a complete redesign of the circuit. A quick fix added a SCART video output, bypassing the RF system. As part of mollifying the client, we also developed a SECAM modulator for the French market—the Dragon was the only computer to have this. But it was all too late, and Dragon Data collapsed in 1984.

One lesson I hope the company learned is that if you are going to do something clever to save money, make sure you thoroughly understand every part of the system that might be affected. Also, if you see anything that doesn't make sense, make sure you properly understand why it's happening before releasing a product.

John Haine, LM
Bristol, U.K.

An Early Microcontroller

As a new B.S.E.E. degree graduate from the University of California, Davis, in 1972, I started work at the Link Division of the Singer Company in Sunnyvale, California, working on visual flight simulation. My initial role at Link was designing and testing digital circuit boards for the visual simulation part of military, commercial, and space flight simulators. The first system we sold was for NASA to use on the Shuttle Mission Simulator. Electrically programmable read-only memories (ROMs or EPROMs in this case) were one of the latest technologies at the time available in 256-b (32 words x 8 b) and 1K-b (256 words x 4 b) sizes fast enough (5 MHz) for our applications. The team realized that these devices could become the basis for flexible and configurable control circuits. The logic to implement this control consisted of a number of EPROMs addressed in parallel with circuitry to enable selected external signals to modify the next address.

In the larger control programs, it would have become quite cumbersome, time consuming, and expensive to burn new EPROMs every time a change to the control code was needed. This caused us to develop an "EPROM simulator" capable of storing 256 words x 80-b-wide control programs in random access memory (RAM). The 256-word limit was due to the size depth of available static RAM memory chips fast enough for our simulator application. The 80-b width was consistent with the 80 columns on then-standard punched cards. This EPROM simulator was designed and built in parallel with the first logic control board so that the simulator would be available for the initial test of the control subsystem. Engineers would first develop a control flowchart on paper and then commit that flowchart to paper coding sheets that contained ones or zeros to be keypunched and verified. We had an old Honeywell computer with a punched card reader and paper tape punch. Our EPROM simulator was then equipped with a paper tape reader, and we were in business.

Because of available static RAM speeds at the time and the design of our simulator, cycle speeds were limited to about 1 MHz. This wasn't full speed, but it was adequate to prove our control and subsystem design concepts. Connecting one of the simulator satellite modules to one of our new control logic boards required up to 20 small flat cables to be connected between the EPROM simulator and control board EPROM IC sockets. It took a fair amount of fiddling and finesse to get one of the simulator modules working reliably while connected to our system. Once solid, however, it remained so as long as it wasn't disturbed or bumped.

Tools for control logic development have certainly evolved tremendously over the past 40+ years. We thought ourselves quite advanced and fortunate to have the facilities we did at the time. The alternatives would have proven both costly and time consuming. The development schedule was always our most ferocious enemy. Having even those primitive tools enabled the engineering teams to accomplish great things against aggressive schedules. The mission simulator only stayed on the first launch critical path for a short time.

Ray Osofsky, LSM
San Jose, CA

Distinguishing Between Hardware and Software Computer Faults

In 1977, I negotiated the lease-purchase of a Harris S123 computer for our Space Plasma Physics research group in the School of Electrical Engineering at Cornell University. This acquisition created a headache for me: I became the default consultant and repair technician, and my own research output was reduced. Yet, there was an ultimate advantage: I became an expert in the Harris Computer System's software and hardware.

As the consultant, many users asked for help in debugging their programs. Help sessions often began with statements claiming that "the system must have failed because their programs stopped working." I would reply with a question asking what they changed in their programs between the time the programs worked and the time they didn't. A typical reply was that their last little change could not possibly be the reason. Of course, upon my examination, those little changes were the culprits and not the system. A number of years later, I seemingly was on my way to falling into a similar trap at the Arecibo Observatory.

In 1985. Dr. Paul Bernhardt of the U.S. Naval Research Laboratory recruited me to run the Arecibo Observatory's incoherent scatter radar to measure the ionospheric effects of a burn of the shuttle orbital maneuvering system (OMS) engines over Puerto Rico. My incoherent scatter radar experience began at Arecibo in 1969 as a Ph.D. candidate at the Pennsylvania State University and continued in 1972 when I joined the School of Electrical Engineering at Cornell. Dr. Bernhardt and I wanted real-time graphics of the ionospheric electron density profiles, a capability Arecibo did not previously possess. Real time was important to ensure successful results without needing subsequent OMS burns. I wrote a program to use a Tektronix 4010 graphics terminal for plotting the real-time electron density profiles.

The launch of the Challenger for STS-51-F was scheduled for 29 July 1985. On the day of the launch, I decided to make an improvement to my program. Once it was complete, the program failed. I tried backing out the change, but the program still did not work. The observatory's director, Dr. Donald Campbell, was furious with me. After running tests on different sections of my program, I discovered that there was no response from the antenna pointing system. Unfortunately, the on-site Harris technician was on vacation. I desperately tried to convince the director to let me swap the interface board for the pointing system with one from their other Harris computer. When he relented, the problem was solved, and the other scientists and visitors gathered around me as the density profiles were plotted on the terminal. Before long, there was a spike from a direct reflection from the shuttle and then the subsequent density profiles showed a bite-out as electrons were depleted by the OBS exhaust gasses. The results of the successful experiment were published in *Journal of Geophysical Research*.

Wesley E. Swartz, LSM
Taylorsville, NC

Keep It Simple

In 1972, while working for TRW Systems in Houston, Texas, as a contractor for the NASA Manned Spacecraft Center (the name of it at that time), my project leader came to me and asked if I wanted to work on a task to estimate the roll angle for the Skylab vehicle. He said that another engineer had worked on it, but this engineer who had more experience and more education than I did at that time was unable to solve the problem. I agreed to undertake the assignment.

After deriving the appropriate equations for the gravity gradient torques that were essential to determining this angle, I approached the problem of trying to solve the angle estimation technique. I was having difficulty solving the problem due to the complexity of the gravity gradient torque equations that I was using. On a Friday afternoon, while driving home to my apartment, it dawned on me that the solution was not to consider the entire equation but to just consider it as a vector. This was a prime example of "not seeing the forest for the trees." I sat down at the dinette table when I got home and worked out the solution.

On Monday morning, I told my project leader that I had solved the problem. Within 15 min, we were at NASA, and I was explaining my solution to some skeptical people since the other engineer had been unsuccessful and had decided that the solution could not be attained. They liked my solution, and I then implemented a Kalman filter and did simulations to determine the parameters required to use for the covariance matrix in the Kalman filter to estimate the required variables in the angle estimation equation. Once I convinced NASA personnel that the Kalman filter could be designed so that I would not have to continually update the covariance matrix, I completed this very gratifying task. This is a good example of the words of Albert Einstein, "Everything should be made as simple as possible, but not simpler."

Walter H. Delashmit, LSM
Justin, TX

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We welcome articles for this newsletter. In particular, we seek articles about projects that are initiated at the Section and Region level by Life Members as well as "Tales from the Vault," which should focus on novel or interesting technical issues. The suggested length for "Tales from the Vault" submissions is 500 words.

Acronyms should be completely identified once. Reference dates (years) also should be included. Editing, including for length, may occur. If you wish to discuss a story idea, you may contact Craig Causer, managing editor, by e-mail at lm-newsletter@ieee.org. The deadline to submit an article for possible inclusion in the next issue is 1 April 2021. Please include your Life grade, city, state, country, phone number, member number, and an email address with your article.

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